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(54) **SYSTEMS AND METHODS FOR ROUTING
INTERNET PROTOCOL TELEPHONY
COMMUNICATIONS**

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H04M 7/00 (2006.01)

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(57) **ABSTRACT**

When IP telephony devices that make use of an Internet protocol (IP) based private branch exchange (PBX) service provider register with the PBX service provider, they furnish local area network address information that indicates how the telephony devices can be reached directly on the local area network to which they are connected. This information is provided to other telephony devices within the same business or organization. As a result, the telephony devices within a business or organization can contact one another directly to setup and conduct telephony communications over a local area network, without the need for such telephony communications to pass over a public data network, or through assets of the IP based PBX service provider.

(52) **U.S. Cl.**

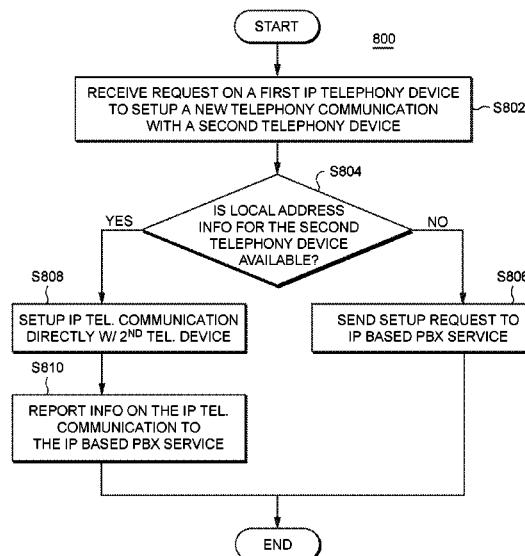
CPC **H04L 65/1069** (2013.01); **H04L 65/1053**
(2013.01); **H04L 65/1056** (2013.01); **H04M**
3/42314 (2013.01); **H04M 7/009** (2013.01);
H04L 29/12094 (2013.01); **H04L 61/20**
(2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

23 Claims, 7 Drawing Sheets



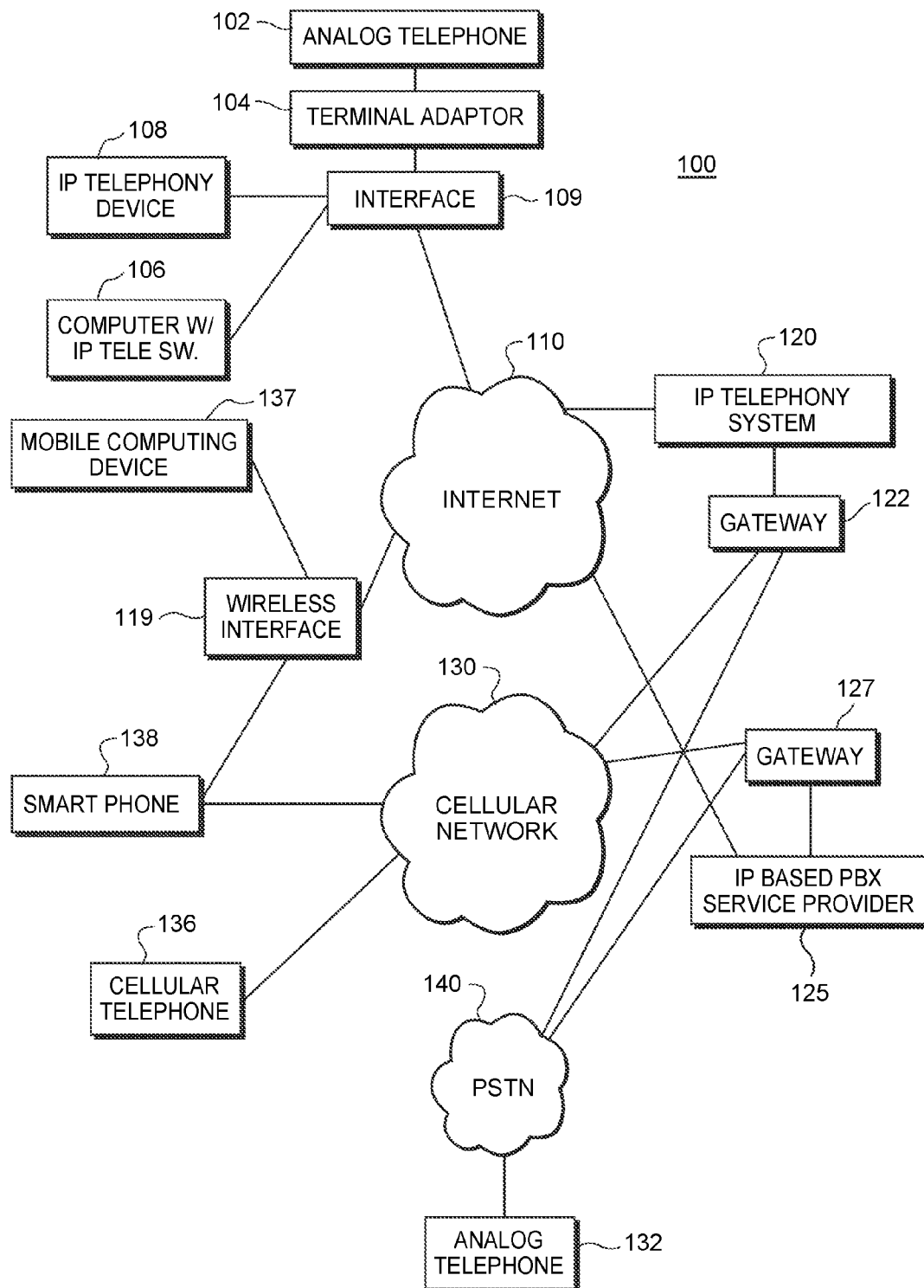


FIGURE 1

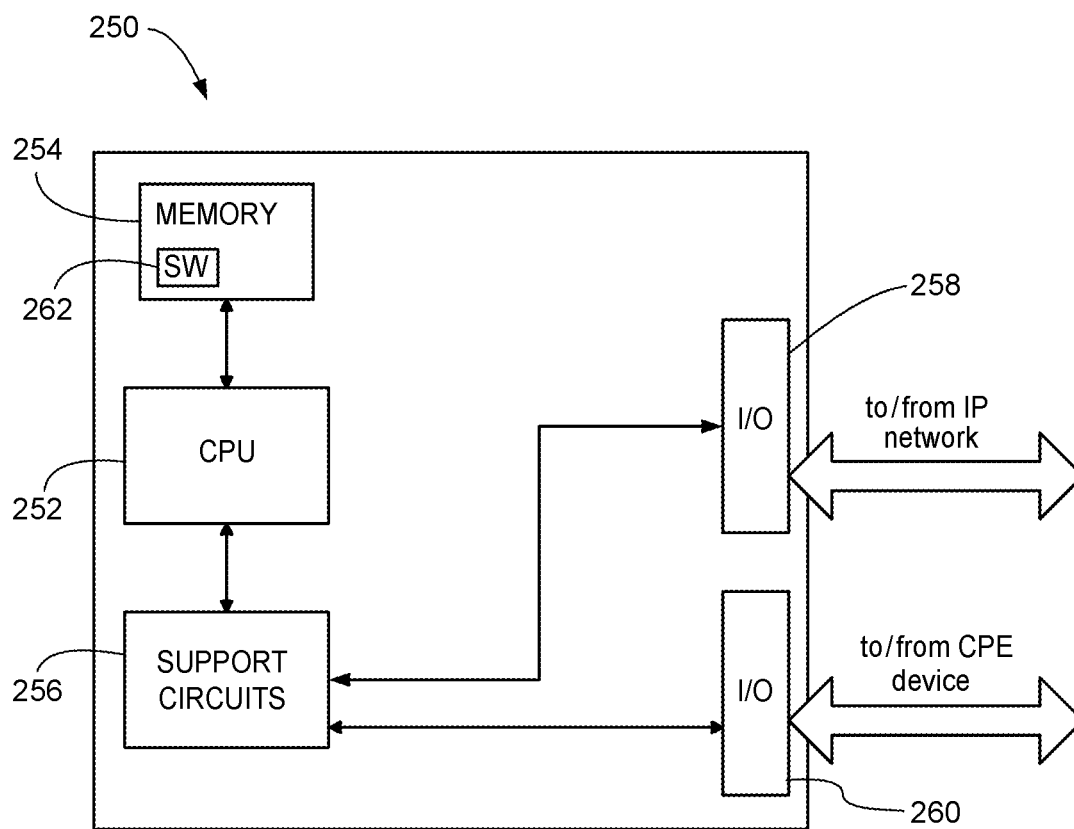


FIGURE 2

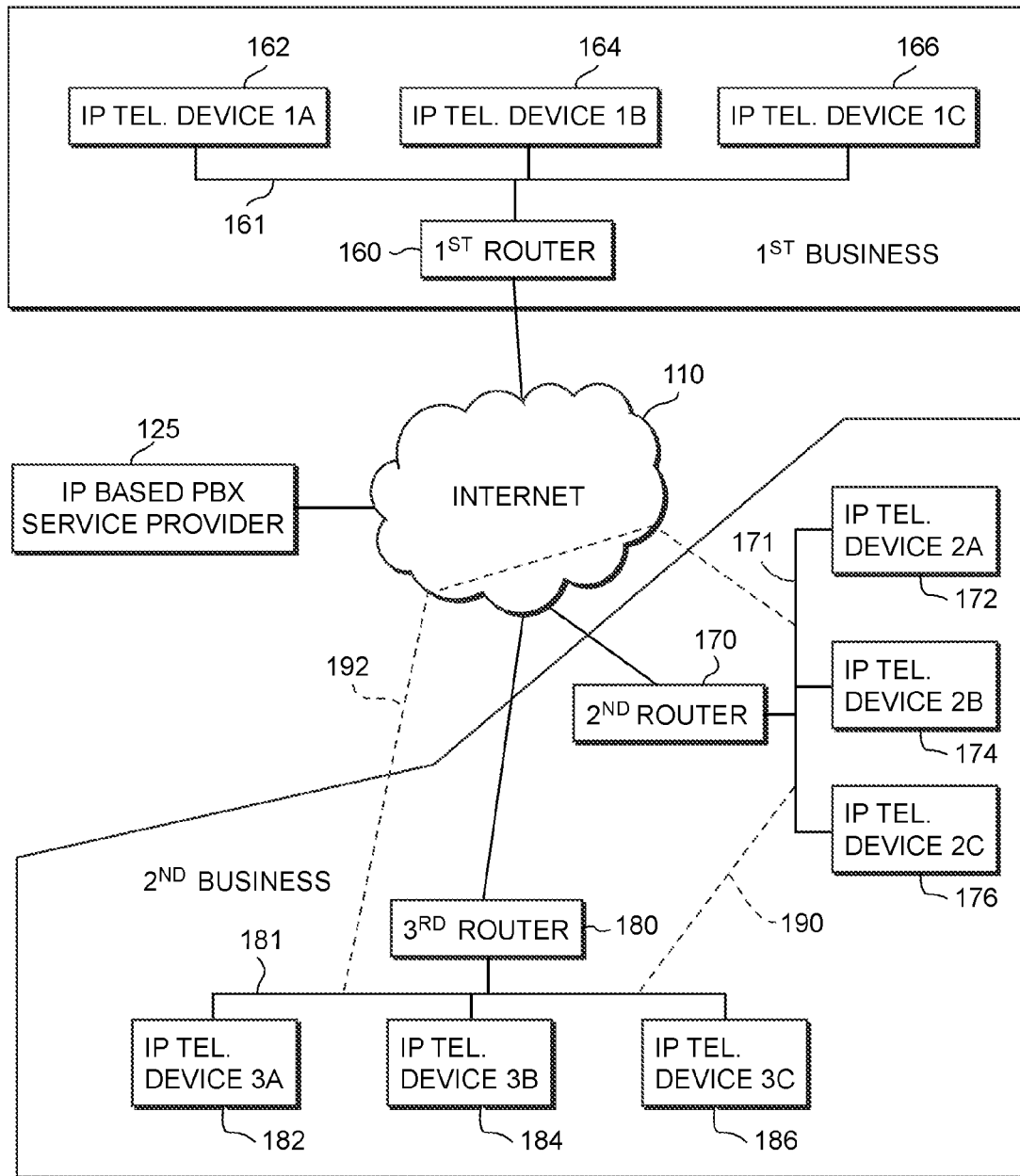


FIGURE 3

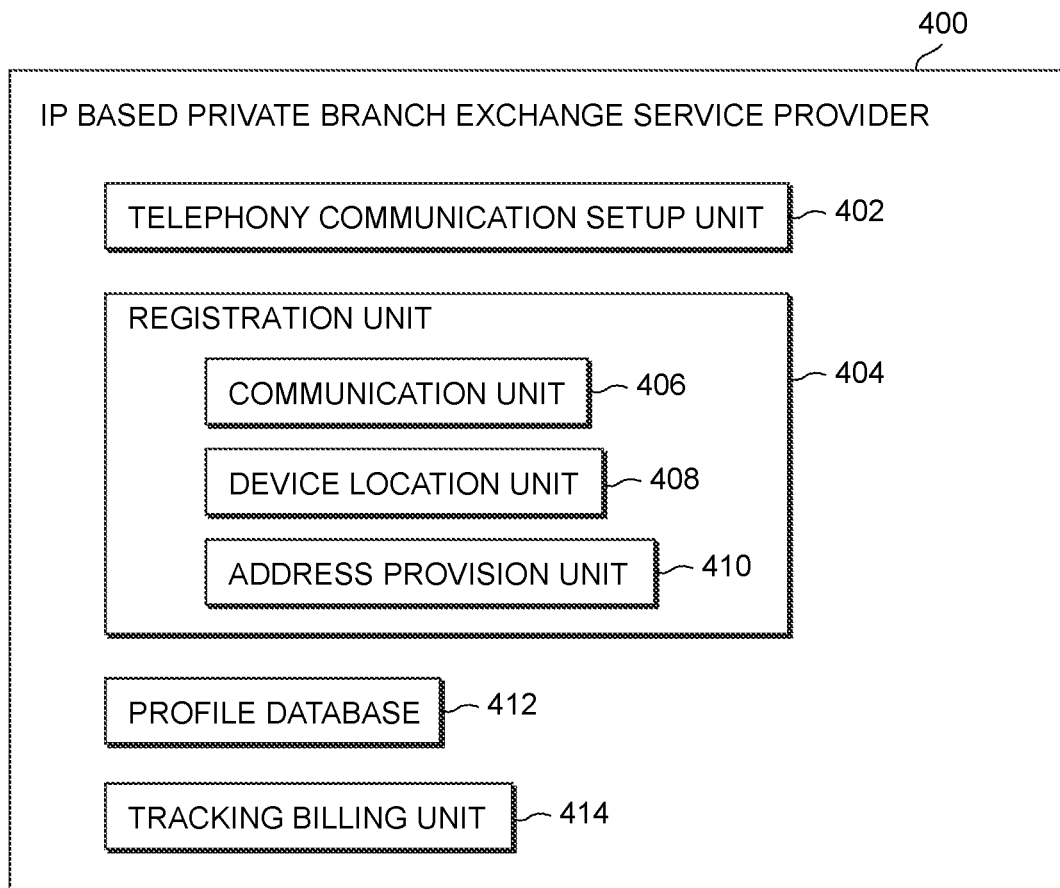


FIGURE 4

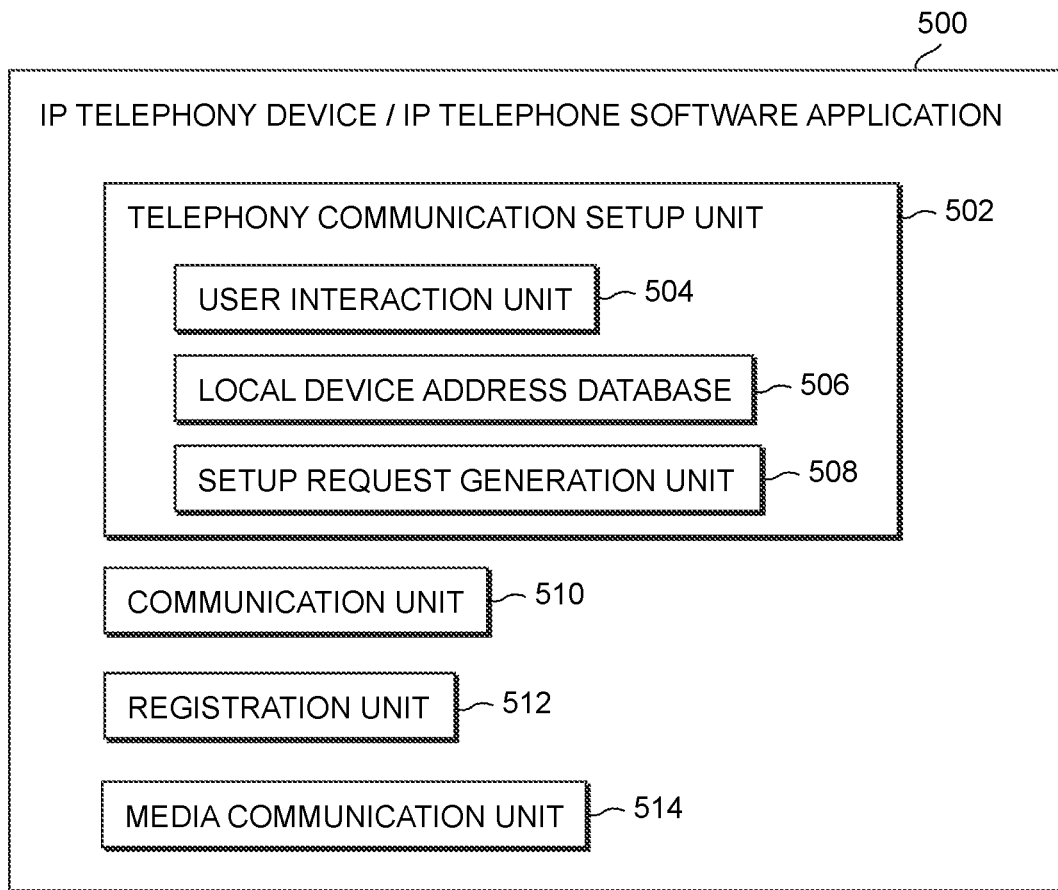
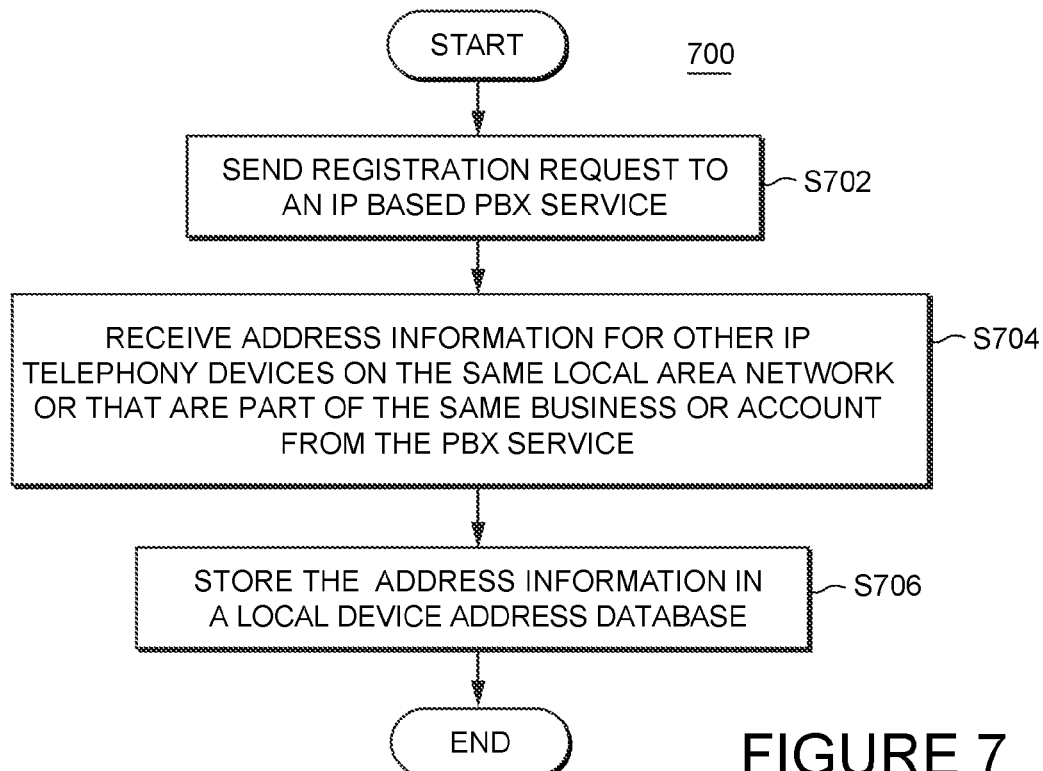
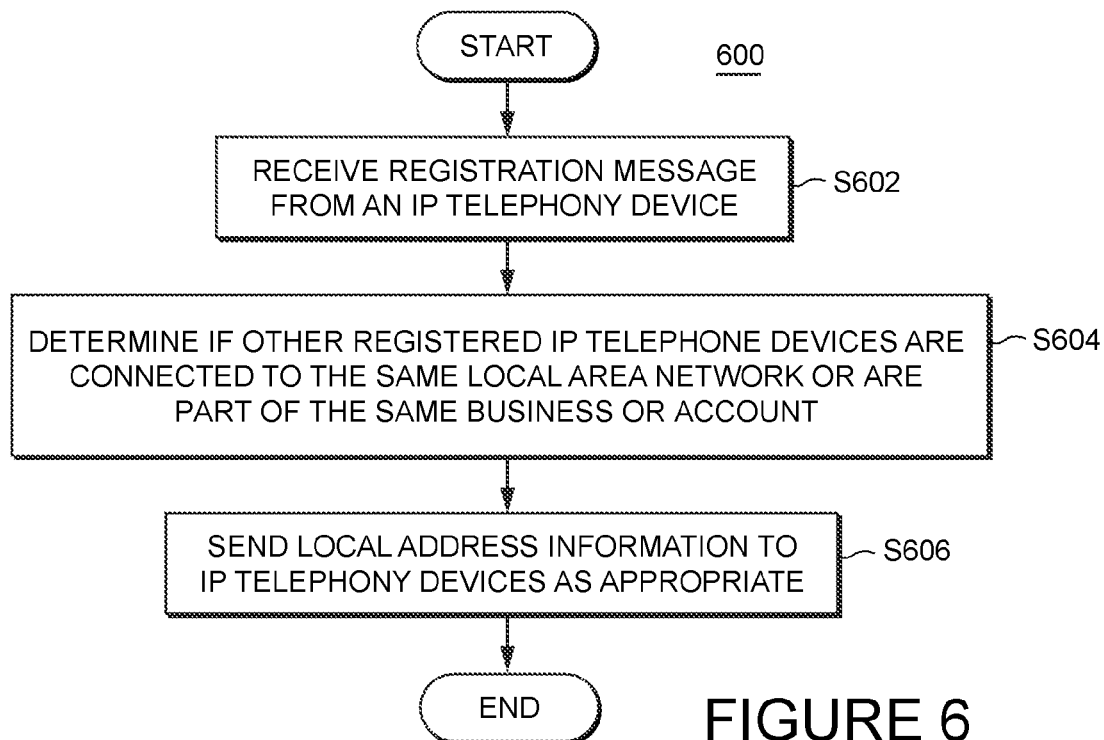


FIGURE 5



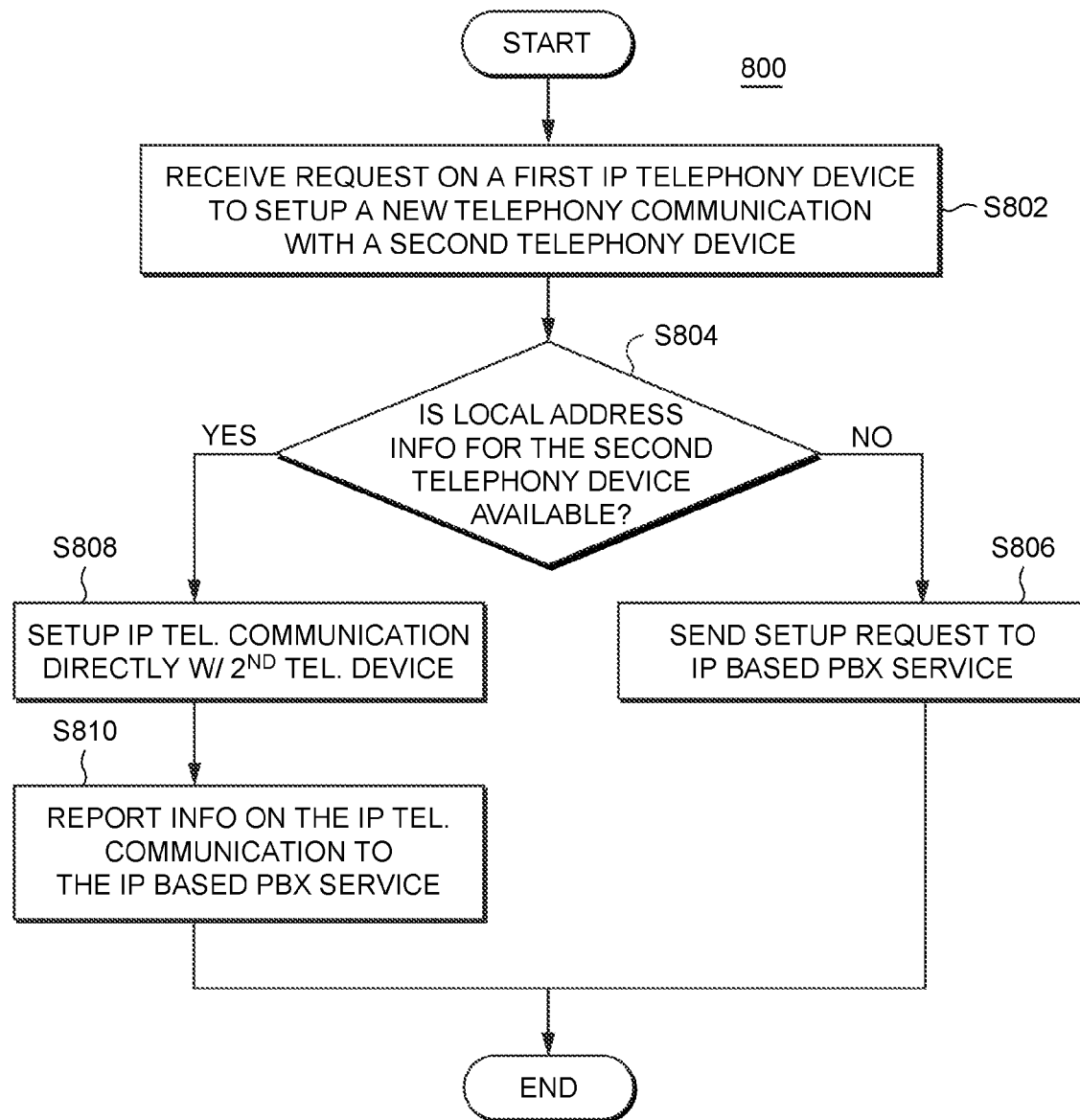


FIGURE 8

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SYSTEMS AND METHODS FOR ROUTING INTERNET PROTOCOL TELEPHONY COMMUNICATIONS

BACKGROUND OF THE INVENTION

The invention is related to Internet protocol (IP) based telephony communications systems. More specifically, the invention is related to IP based private branch exchange systems and service providers.

Traditionally, a professional services business that employed multiple individuals would provide each individual with a telephone at their respective desk. However, in light of the fact that it is unusual in most businesses for all the employees to be conducting telephone calls at the same time, the business would not have a separate telephone line connected to each telephone. Instead, the business would acquire a lesser number of external telephone lines, and those external telephone lines would be coupled to a special switching unit located within the business. Each of the employee telephones also would be coupled to the switching unit. The switching unit allows any employee telephone to be connected to any of the external telephone lines. The switching unit also allows a receptionist to answer each incoming telephone call, and then connect that call to the appropriate employee telephone. Such a switching system is commonly known as a private branch exchange (PBX) system.

The heart of a traditional the private branch exchange system is the switching unit to which the external lines and the employee telephones are connected. Unfortunately, such switching systems are relatively expensive. In addition, if a growing business purchases a first switching system with a certain capacity, it is common for the business to outgrow the first switching system. This usually means that the business must purchase a new, larger capacity switching system, and then discard or resell the first switching system.

With the rise in Internet protocol (IP) telephony systems, some IP telephony service providers have begun to offer telephony services that mimic a traditional private branch exchange system. Instead of all employee telephones being connected to a central switching unit located at the business, each employee is provided with an IP telephony device which is coupled to the Internet. When an employee's IP telephony device is first coupled to the Internet, it registers with the private branch exchange service provider, providing an Internet address at which it can be reached. Thereafter, incoming telephone calls can be directed to the employee telephone by the private branch exchange service provider via the Internet. Likewise, if an employee wishes to place an outgoing telephone call, the outgoing call is setup through the private branch exchange service provider via the Internet.

An IP based private branch exchange service has several advantages over a traditional switching unit based private branch exchange system. First, because employee IP telephony devices need only be connected to the Internet, the employees can be located virtually anywhere they can obtain access to the Internet. There is no longer a need for an employee telephony device to be hard wired to a PBX switching unit.

In addition, an IP based private branch exchange service provider can allow a business to scale upward and downward, in terms of the number of users, with few limits. Thus, a business is no longer locked into a PBX switching unit with a fixed capacity. There is also no longer a need for a business to purchase or lease the expensive switching unit associated with a PBX system.

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On the other hand, an IP based private branch exchange service also has certain inherent disadvantages. Chief among them is that Internet connectivity is required to receive incoming calls and place outgoing calls. Even if a first employee of a business wishes to place an intra-office call to a second employee of the same business, in the same building, it is necessary for the call to be routed through the IP based private branch exchange service, which is only reachable via the Internet. This is true even when the first and second employees' IP telephony devices are connected to the same local area network that provides access to the Internet.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram of a communications environment including various elements which are associated with an Internet protocol (IP) telephony system and an IP based private branch exchange service provider in accordance with an embodiment of the invention;

FIG. 2 is a diagram of various elements of a processor that forms part of an IP telephony system, an IP based private branch exchange service provider, or an IP telephony device according to embodiments of the invention;

FIG. 3 is a diagram illustrating the functional connections between an IP based private branch exchange service provider and the individual IP telephony devices that utilize the services of the IP based private branch exchange service provider;

FIG. 4 is block diagram illustrating various elements of an IP based private branch exchange service provider according to an embodiment of the invention;

FIG. 5 is a block diagram of various elements of an IP telephony device or an IP telephony software application which may be resident on a user's telephony device according to an embodiment of the invention;

FIG. 6 is a flowchart illustrating steps of a method that would be performed by elements of an IP based private branch exchange service provider to receive registration requests from user IP telephony devices and to provide local address information to user IP telephony devices;

FIG. 7 is a flowchart illustrating steps of a method that would be performed by user IP telephony devices to register with an IP based private branch exchange service and to receive and store local address information for other user IP telephony devices; and

FIG. 8 is a flowchart illustrating steps of a method of that would be performed by a user IP telephony device to setup a new IP based telephony communication.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The following detailed description of preferred embodiments refers to the accompanying drawings, which illustrate specific embodiments of the invention. Other embodiments having different structures and operations do not depart from the scope of the present invention.

In the following description, the terms VOIP system, VOIP telephony system, IP system and IP telephony system are all intended to refer to a system that connects callers and that delivers data, text or video communications using Internet protocol data communications. Similarly, an IP based private branch exchange (PBX) service provider may perform similar functions.

As illustrated in FIG. 1, a communications environment 100 is provided to facilitate IP based communications. An IP telephony system 120 enables connection of telephone calls

between its own customers and other parties via data communications that pass over a data network. The data network is commonly the Internet **110**, however, private data networks may form all or a portion of the data communication path. The IP telephony system **120** is connected to the Internet **110**. In addition, the IP telephony system **120** is connected to a publicly switched telephone network (PSTN) **140** and/or a cellular network **130** via one or more gateways **122**.

Likewise, an IP based PBX service provider **125** is configured to connect telephone calls between its own customers and other parties via data communications that pass over a data network. The IP based PBX service provider **125** is connected to a publicly switched telephone network (PSTN) **140** and/or a cellular network **130** via one or more gateways **127**, or directly, so that customers of the IP based PBX service provider **125** can be connected to parties that are reachable only through the PSTN **140** or cellular network **130**.

In some instances, the gateways **122**, **127** would be a part of the IP telephony system **120** and/or the IP based PBX service provider **125**. In other instances, the gateways **122**, **127** could be maintained by a third party.

Customers of the IP telephony system **120** and/or the IP based PBX service provider **125** can place and receive telephone calls using an IP telephone **108** that is connected to the Internet **110** via a data network interface **109**. The IP telephone **108** could be connected to the data network interface **109** via a wired or wireless connection.

Alternatively, a customer could utilize a normal analog telephone **102** which is connected to the Internet **110** via a terminal adapter **104** and the data network interface **109**. The terminal adapter **104** converts analog signals from the telephone **102** into data signals that pass over the Internet **110**, and vice versa. Analog telephony devices include, but are not limited to, standard telephones and document imaging devices such as facsimile machines. A configuration using a terminal adapter **104** is common where the analog telephone **102** is located in a residence or business.

In addition, a customer could utilize a computer that is running IP telephony software **106** to place and receive IP based telephone calls, and to access other IP telephony systems (not shown). Here again, the computer running IP telephony software **106** would access the Internet **110** via the data network interface **109**. In some instances, the IP telephony software could be assigned its own telephone number. In other instances, the IP telephony software could be associated with a telephone number that is also assigned to an IP telephone **108**, or to a terminal adaptor **104** that is connected to an analog telephone **102**.

In addition, a mobile computing device **137** which is running IP telephony software could also be used to place and receive telephone calls through the IP telephony system **120** and/or the IP based PBX service provider **125**. The mobile computing device **137** accesses the Internet **110** via a wireless data network interface **119**. The wireless data network interface could be a WiFi or WiMax router, or any other type of wireless data interface device capable of communicating wirelessly with the mobile computing device **137**.

A third party using an analog telephone **132** which is connected to the PSTN **140** may call a customer of the IP telephony system **120** and/or the IP based PBX service provider **125**. In this instance, the call is initially connected from the analog telephone **132** to the PSTN **140**, and then from the PSTN **140**, through the gateways **122**, **127** to the IP telephony system **120** or the IP based PBX service provider **125**. The IP telephony system **120** or IP based PBX service provider **125** then routes the call to the customer's IP telephony device. A third party using a cellular telephone **136** could also place a

call to a customer of the IP telephony system **120** or IP based PBX service provider **125**, and the connection would be established in a similar manner, although the first link would involve communications between the cellular telephone **136** and a cellular telephone network **130**.

A smart phone **138** which includes cellular telephone capabilities could also be used to conduct telephony communications through the IP telephony system **120**, the IP based PBX service provider **125** and/or the cellular network **130**. For example, an IP telephony software application running on the smart phone **138** could communicate with the IP based PBX service provider **125** via the Internet **110**. The smart phone **138** could access the Internet **110** via the wireless data network interface device **119**, or via a data channel of the cellular network **130**. Of course, alternate embodiments could utilize any other form of wired or wireless communications paths to enable communications.

Users of the IP telephony system **120** and the IP based PBX service provider **125** are able to access the services of these systems from virtually any location where they can connect to the Internet **110**. Thus, a customer could register with an IP based PBX service provider **125** located in the U.S., and that customer could then use an IP telephone **108** located in a country outside the U.S. to access the services. Likewise, the customer could also utilize a computer outside the U.S. that is running IP telephony software to access the IP based PBX service provider **125**. Further, in some instances a user could place a telephone call with the analog telephone **132** or the cellular telephone **136** that is routed through the PSTN **130** or cellular network **140** to the IP based PBX service provider **125** via the gateway **127**. This would typically be accomplished by the user calling a local telephone number that is routed to the IP based PBX service provider **125** via the gateway **127**. Once connected to the IP based PBX service provider **125**, the user may then place an outgoing long distance call to anywhere in the world using the IP based PBX service provider **125**. Thus, the user is able place a long distance call using lower cost IP telephony service provided by the IP based PBX service provider **125**, rather than a higher cost service provided by the PSTN **140** or cellular network **130**.

FIG. 2 illustrates elements of a computer processor **250** that can be used as part of the IP telephony system **120**, the IP based PBX service provider **125**, or a telephony device to accomplish various functions. The IP telephony system **120** or the IP based PBX service provider **125** could include multiple processors **250** located at various locations in the system, along with their operating components and programming, each carrying out a specific or dedicated portion of the functions performed by the IP telephony system **120** or IP based PBX service provider **125**.

The processor **250** shown in FIG. 2 may be one of any form of a general purpose computer processor used in accessing an IP-based network, such as a corporate intranet, the Internet or the like. The processor **250** comprises a central processing unit (CPU) **252**, a memory **254**, and support circuits **256** for the CPU **252**. The processor **250** also includes provisions **258/260** for connecting the processor **250** to customer equipment, to service provider equipment, to and IP network or gateways, as well as possibly one or more input/output devices (not shown) for accessing the processor and/or performing ancillary or administrative functions related thereto. The provisions **258/260** are shown as separate bus structures in FIG. 2; however, they may alternately be a single bus structure without degrading or otherwise changing the intended operability of the processor **250**.

The memory **254** is coupled to the CPU **252**. The memory **254**, or computer-readable medium, may be one or more of readily available memory such as random access memory (RAM), read only memory (ROM), floppy disk, hard disk, flash memory or any other form of digital storage, local or remote, and is preferably of non-volatile nature. The support circuits **256** are coupled to the CPU **252** for supporting the processor in a conventional manner. These circuits include cache, power supplies, clock circuits, input/output circuitry and subsystems, and the like.

A software routine **262**, when executed by the CPU **252**, causes the processor **250** to perform processes of the disclosed embodiments, and is generally stored in the memory **254**. The software routine **262** may also be stored and/or executed by a second CPU (not shown) that is remotely located from the hardware being controlled by the CPU **252**. Also, the software routines could also be stored remotely from the CPU. For example, the software could be resident on servers and memory devices that are located remotely from the CPU, but which are accessible to the CPU via a data network connection.

The software routine **262**, when executed by the CPU **252**, transforms the general purpose computer into a specific purpose computer that performs one or more functions of the IP telephony system **120** or IP based PBX service provider **125**. Although the processes of the disclosed embodiments may be discussed as being implemented as a software routine, some of the method steps that are disclosed therein may be performed in hardware as well as by a processor running software. As such, the embodiments may be implemented in software as executed upon a computer system, in hardware as an application specific integrated circuit or other type of hardware implementation, or a combination of software and hardware. The software routine **262** of the disclosed embodiments is capable of being executed on any computer operating system, and is capable of being performed using any CPU architecture.

References to an "IP telephony device" appear in both the foregoing and following descriptions. This term is used to refer to any type of device which is capable of interacting with an IP telephony system to conduct a communication. An IP telephony device could be an IP telephone, a computer running IP telephony software, a telephone adapter which is connected to an analog telephone, or some other type of device capable of communicating via data packets. An IP telephony device could also be a cellular telephone or a portable or tablet computing device that runs a software client that enables the device to act as an IP telephone. Thus, a single device might be capable of operating as both a cellular telephone and an IP telephony device.

Moreover, certain devices that are not traditionally used as telephony devices may act as telephony devices once they are configured with appropriate client software. Thus, some devices that would not normally be considered telephony devices may become telephony devices or IP telephony devices once they are running appropriate software. One example would be a desktop or a laptop computer that is running software that can interact with an IP telephony system over a data network to conduct telephone calls. Another example would be a portable computing device, such as an Apple iPod Touch™, which includes a speaker and a microphone. A software application loaded onto an Apple iPod Touch™ can be run so that the Apple iPod Touch™ can interact with an IP telephony system to conduct a telephone call.

The following description will also refer to telephony communications and telephony activity. These terms are intended

to encompass all types of telephony communications, regardless of whether all or a portion of the communications are carried in an analog or digital format. Telephony communications could include audio or video telephone calls, facsimile transmissions, text messages, SMS messages, MMS messages, video messages, and all other types of telephony and data communications sent by or received by a user. These terms are also intended to encompass data communications that are conveyed through a PSTN or VOIP telephony system. In other words, these terms are intended to encompass any communications whatsoever, in any format, which traverse all or a portion of a communications network or telephony network.

FIG. 3 depicts the functional connections between an IP based PBX service provider **125** and two businesses that utilize the PBX services of the IP based PBX service provider **125**.

A first business has a first local area network **161** that is connected to the Internet **110** via a 1st router **160**. User IP telephony devices **162**, **164**, **166** are coupled to the first local area network **161**, and can access the Internet **110**, and the IP based PBX service provider **125** via the 1st router **160**.

The second business has two separate physical locations. A second local area network **171** is present at the first physical location. A second router **170** connects the second local area network **171** to the Internet **110**. User IP telephony devices **172**, **174**, **176** are coupled to the second local area network **171** and can access the Internet **110** and the IP based PBX service provider **125** via the second router **170**. A third local area network **181** is present at a second physical location of the second business. A third router **180** couples the third local area network **181** to the Internet **110**. User telephony devices **182**, **184**, **186** are coupled to the third local area network **181** and can access the Internet **110** and the IP based PBX service provider **125** via the third router **180**.

In some embodiments, when a business has multiple local area networks, a virtual private network connection may be established between the local area networks such that IP telephony devices connected to a first local area network can directly contact IP telephony devices on a second local area network. The virtual private network connection could be established over a private data network or over the Internet.

For example, the second business illustrated in FIG. 3 utilizes the second local area network **171** and the third local area network **181**. In some embodiments, a virtual private network connection **190** could be established between the second local area network **171** and the third local area network **181** over a private data network owned or controlled by the second business. Alternatively, a virtual private network connection **192** could be established between the second local area network **171** and the third local area network **181** over the Internet **110**. In either case, this would allow the IP telephony devices **172**, **174**, **176** connected to the second local area network **171** to communicate directly with the IP telephony devices **182**, **184**, **186** connected to the third local area network **181**, even though the two local area networks are in two different physical locations.

When the first and second businesses setup their PBX services with the IP based PBX service provider **125**, they can cede control over their central telephone lines to the PBX service provider **125**. Thereafter, when an incoming call is placed to the first business's main telephone number, the call will be routed to the PBX service provider **125**, and the PBX service provider **125** can connect the call to a receptionist or to an individual at the first business. Calls to telephone numbers assigned to the user IP telephony devices **162**, **164**, **166** also initially would be routed to the IP based PBX service

provider **125**, and the PBX service provider **125** would route the calls to appropriate user IP telephony devices.

A similar situation would pertain for the second business. However, the second business has two separate physical locations. This fact would be virtually undetectable to people outside the business who place a call to a main telephone number of the second business or to a telephone number associated with one of the user IP telephony devices.

It is common for PBX systems that utilize a physical switching device to allow a first user with a first telephony device connected to the PBX switching device to place a call to a second user of a second telephony device connected to the PBX switching device without actually placing a call through an outside telephony system, such as the PSTN. Often, the first user can simply dial the extension number of the second user, and the PBX switching device directly connects the two parties without making use of an outside telephone line.

In the case of IP based PBX telephony systems, however, whenever a user wishes to setup a telephony communication with another party, the telephony communication is routed through the IP based PBX service provider. This is true for calls to parties outside the business, and also for calls to other users within the same business. Thus, if a first person at the first business using IP telephony device **162** wishes to setup a telephony communication with a second person at the first business using IP telephony device **166**, the telephony communication is still routed through the IP based PBX service provider **125**. This, of course, requires that the telephony communication be routed over the Internet **110**. If Internet connectivity is lost or impaired, then it is impossible for the first person using IP telephony device **162** to talk to the second person using IP telephony device **166**, even though the first and second IP telephony devices **162**, **166** are connected to the same local area network **161**.

In the systems and methods described below, each of the individual user IP telephony devices that are associated with the same business or account are informed of the local addresses of the other IP telephony devices associated with the same business or account. This local address information is stored in local memory of the IP telephony devices. When a first person within a business wishes to setup a telephony communication with a second person within the same business, the first person's IP telephony device first checks for local address information for the second person's IP telephony device. If this local address information is available, the first person's IP telephony device sets up the telephony communication directly with the second person's IP telephony device, likely over a local area network, without involving assets of the IP based PBX service provider. In many instances, this eliminates the need to send any portion of the telephony communication over the Internet. Thus, the communication can be conducted, even when Internet access is unavailable or impaired. This method of conducting internal telephony communications also reduces the business' consumption of Internet bandwidth, freeing that bandwidth for other purposes. Further, communicating in this fashion frees the assets of the IP based PBX service provider for other uses.

FIG. 4 illustrates selected elements of an IP based PBX service provider **400** embodying the invention. The elements include a telephony communication setup unit **402** that sets up telephony communications for users. This includes incoming calls directed to a user's telephone number and outgoing calls initiated by a user. A registration unit **404** registers user IP telephony devices when they are first connected to the Internet. The registration unit **404** may also periodically communicate with user IP telephony devices via routers to ensure

that connectivity between the IP based PBX service provider **400** and the user IP telephony devices is maintained. Specifically, such periodic communications may be necessary to keep a pinhole timer of a router open so that the IP based PBX service provider can always send a new communication to a user IP telephony device.

The registration unit **404** includes a communication unit **406** that is responsible for communicating with user IP telephony devices. A device location unit **408** determines when two or more IP telephony devices are connected to the same local area network, and/or are associated with the same business or account. This determination process will be described in detail below. An address provision unit **410** tracks the local addresses of each of the user IP telephony devices on their respective local area networks. This allows the local address information to be provided to individual user IP telephony devices, when appropriate, as will be discussed in detail below.

A profile database **412** contains profile information for individual users and their IP telephony devices. This information can be helpful in ensuring that communications to and from a user's IP telephony device are conducted in the proper format. The profile database **412** may also include information about the current status of individual user telephony devices. For example, the profile database **412** may indicate when a user IP telephony device is conducting a telephony communication. In that instance, if a new incoming call directed to the user IP telephony device is received, it could be routed to voicemail or handled in some other fashion. The profile database **412** also may include information about limitations on the telephony services that can be provided to individual user IP telephony devices. For example, some user IP telephony devices may be blocked from initiating outgoing international calls, or from conducting certain toll bearing calls.

A tracking/billing unit **414** tracks the communications activity of user IP telephony devices and bills a business accordingly for that usage.

Although the elements illustrated in FIG. 4 may be present in some embodiments of an IP based PBX service provider, in other embodiments additional elements may also be present. Likewise, not all of the elements illustrated in FIG. 4 may be present in all embodiments of an IP based PBX service provider. Thus, FIG. 4, and the description provided above, should in no way be considered limiting.

FIG. 5 illustrates selected elements of a user IP telephony device embodying the invention. Alternatively, FIG. 5 could illustrate elements that may be present in IP telephony software that is running on a computing device or smart phone, and which configures the computing device or smart phone to act as a user IP telephony device.

The elements include a telephony communication setup unit **502** that is responsible for setting up new telephony communications for the user. The telephony communication setup unit **502** includes a user interaction unit **504** that interacts with a user to receive user instructions and to obtain information from the user. The user interaction unit **504** can make use of various different user interfaces including display screens, speakers, microphones and speech recognition software to interact with a user.

A device local address database **506** stores local address information for other user telephony devices. As explained above, this information could be used to setup new telephony communications directly with another user's IP telephony device, thereby bypassing the IP based PBX service provider. In instances where a business has multiple physical locations, the information in the local device address database may

enable a first user's IP telephony device at a first physical location to setup a new telephony communication with a second user's IP telephony device that is located at a second physical location. The information stored in the local device address database **506** could be obtained from the IP based PBX service provider, from the other IP telephony devices, or from other sources. The local device address database may be present in a non-volatile memory module of an IP telephony device.

A setup request generation unit **508** generates setup requests for new telephony communications. A setup request could take the form of a Session Initiation Protocol (SIP) Invite message. However, other setup request formats also could be used. The way in which a setup request is generated by the setup request generation unit **508** is explained in detail below.

A communication unit **510** is responsible for actually communicating a setup request to either the IP based PBX service provider, or another user IP telephony device. In some instances, the communication unit **510** also may send information about the status of the IP telephony device to the IP based PBX service provider, such as whether the user IP telephony device is engaged in a telephony communication. The communication unit **510** also may receive local address information for other IP telephony devices, and store this local address information in the local address database **506**.

A registration unit **512** is responsible for registering the IP telephony device **500** with an IP based PBX service provider. The information sent by the registration unit **512** to the IP based PBX service provider could include a local address of the IP telephony device on a local area network.

A media communication unit **514** is responsible for communicating data packets bearing the media of a telephony communication once a telephony communication has been setup.

Although the elements illustrated in FIG. **5** may be present in some embodiments of an IP telephony device, or in an IP telephony software application, in other embodiments additional elements also may be present. Likewise, not all of the elements illustrated in FIG. **5** may be present in all embodiments of an IP telephony device or an IP telephony software application. Thus, FIG. **5**, and the description provided above, should in no way be considered limiting.

FIG. **6** illustrates steps of a method that is performed by elements of the IP based PBX service provider to receive a registration request from a user IP telephony device, and to disseminate local address information, as appropriate. For ease of explanation, the following description assumes that the registration request is received from an IP telephony device. However, the registration request also could have been received from an IP telephony software application running on a user's computing device or smart phone.

The method **600** begins and proceeds to step **S602**, where the communication unit **406** of a registration unit **404** of the IP based PBX service provider **400** receives a registration request from a first user's IP telephony device. The registration request will have been received from a particular IP address at which the first user's IP telephony device can be reached. If the registration request is sent through a router, the registration request will likely indicate a port number of the router at which the IP telephony device can be reached. If the IP telephony device is coupled to a local area network, local address information for the first user's IP telephony device on the local area network will be included in the registration request. The local address information can include an internal IP address and port number that has been assigned to the first user's IP telephony device on the local area network. The

internal IP address and port number could be used by a second user's IP telephony device that is connected to the same local area network to directly contact the first user's IP telephony device over the local area network. Also, in situations where two local area networks are connected to one another by a virtual private network connection, a third user's IP telephony device connected to a different local area network could use the local address information to directly contact the first user's IP telephony device via the virtual private network connection.

In some embodiments, the registration request also may include information identifying the business or account with which the first user's IP telephony device is associated. This could be an account number that the business has with the IP based PBX service provider.

In step **S604** the device location unit **408** of the registration unit **404** determines if other registered IP telephony devices are connected to the same local area network, and/or are associated with the same business or account as the first user's IP telephony device. In some embodiments, the device location unit **408** assumes that any other IP telephony device that sent a registration message originating from the same IP address as the first user's IP telephony device is connected to the same local area network as the first user's IP telephony device, and therefore is associated with the same business or account. This would be the case if all of the IP telephony devices are communicating through the same router connected to a local area network. In other embodiments, information identifying the local area network may be included in the registration request sent by the first user's IP telephony device, and this identifying information is compared to corresponding information provided by other IP telephony devices that have registered to determine if the first user's IP telephony device is connected to the same local area network as the other IP telephony devices. In still other embodiments, a business or account identifier that is included with registration information provided by the first user's IP telephony device is compared to the identifiers provided by other registered IP telephony devices. Thus, even where two IP telephony devices are connected to different local area networks, and register from different public IP addresses, the device location unit **408** is able to determine that they are associated with the same business or account. Other techniques also may be used to determine if the if other registered IP telephony devices are associated with the same business or account, or are connected to the same local area network as the registering IP telephony device.

In step **S606**, the address provision unit **410** uses the communication unit **406** to send local address information to those IP telephony devices that should receive it. How this step is performed will vary depending on the result of the determination made in step **S604**.

If performance of step **S604** indicates that several other user IP telephony devices that have already registered with the system are present on the same local area network as the registering IP telephony device, or are associated with the same business or account, then in step **S606** the address provision unit **410** sends local address information for the registering IP telephony device to each of those other IP telephony devices that are connected to the same local area network and/or that are associated with the same business or account. Likewise, the address provision unit **410** sends local address information for each of the IP telephony devices that are connected to the same local area network and/or that are associated with the same business or account and that have already registered to the registering IP telephony device. As a result, all of the IP telephony devices connected to the same

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local area network and/or all of the IP telephony devices that are associated with the same business or account are informed of the local address information for each of the other registered IP telephony devices connected to the same local area network or that are associated with the same business or account. This allows all of the registered IP telephony devices connected to the same local area network or that are associated with the same business or account to setup telephony communications directly with each other, thereby eliminating or at least reducing the need to setup those telephony communications through the IP based PBX service provider.

FIG. 7 illustrates steps of a method that would be performed by an IP telephony device to register with the IP based PBX service provider. The method 700 begins and proceeds to step S702 where the registration unit 512 of a user IP telephony device or an IP telephony software application sends a registration message to the registration unit 404 of an IP based PBX service provider. The registration message includes local address information that indicates how other IP telephony devices can contact the registering IP telephony device to setup new IP telephony communications. The registration message may also include information about the business or account with which the IP telephony device is associated.

Next, in step S704, the IP telephony device receives local address information for other registered IP telephony devices that are connected to the same local area network, and/or that are associated with the same business or account, from the address provision unit 410 of the IP based PBX service provider. This local address information empowers the IP telephony device to setup new telephony communications directly with the other IP telephony devices connected to the same local area network or that are associated with the same business or account.

In step S706, the registering IP telephony device stores the local address information in a local device address database 506 of a telephony communication setup unit 502 of an IP telephony device or an IP telephony software application 500. As mentioned above, the local device address database may be stored in a non-volatile data storage unit of a telephony device. As a result, if the telephony device is turned off and on, or cycles through a re-boot, the local device address information will still be present. Also, if the telephony device re-registers with an IP telephony system, it may obtain updated local address information as part of the re-registration process, and then update the information in the local device address database accordingly. The method then ends.

In some embodiments, an address provision unit 410 of an IP based PBX service provider may send out periodic updates of local address information to individual user telephony devices, or to IP telephony software applications. These updates may be periodic in nature, and convey all changes in local address information which has occurred since the last update. Alternatively, a change in the local address information for first telephony device/IP telephony software application may trigger the address provision unit 410 to send out the new local address information for that first telephony device/IP telephony software application to other telephony devices/IP telephony software applications that may be interested in directly contacting the first telephony device/IP telephony software application.

FIG. 8 illustrates steps of a method that is performed by a first IP telephony device or IP telephony device software application to setup a new telephony communication with another telephony device that is connected to the same local area network and/or that is associated with the same business or account. The method 800 begins and proceeds to step

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S802, where a user interaction unit 504 of the first IP telephony device receives a request to setup the new telephony communication with a second telephony device. In step S804, a check is performed to determine if local address information for the second telephony device is present in a device local address database 506 of the first IP telephony device. This would be the case if the second telephony device is also registered with the IP based PBX service provider, and the second telephony device is connected to the same local area network or is associated with the same business or account.

If the determination in step S804 indicates that no local address information is available the second telephony device in the local address database 506, the method proceeds to step S806, and the setup request generation unit 508 generates a telephony communication setup request that is sent by the communication unit 510 to the IP based PBX service provider. The telephony communication setup unit 402 of the IP based PBX service provider then sets up the requested telephony communication with the second telephony device.

If the determination in step S804 indicates that local address information is available for the second telephony device, the method proceeds to step S808, and the setup request generation unit 508 generates a telephony communication setup request that is sent directly to the second telephony device. The setup request could be sent over the same local area network to which the first IP telephony device is connected, or the setup request might traverse a virtual private network connection to another local area network to which the second IP telephony device is connected. The first IP telephony device and the second telephony device then setup and conduct the telephony communication. During the telephony communication, the media communication unit 514 of the first IP telephony device sends and receives data packets bearing the media of the telephony communication.

In some embodiments, the method will also include a step S810, where the first and/or second IP telephony device sends information about the telephony communication to the IP based PBX service provider. This could include a first message that indicates the telephony communication has commenced, which would inform the IP based PBX service provider that both the first and second telephony devices are now engaged in a telephony communication, and are not presently available for new incoming telephony communications that originate from other telephony devices. Likewise, when the telephony communication between the first and second telephony devices ends, the first and/or second telephony devices may send a message to the IP based PBX service provider indicating that the telephony communication has ended, and that the first and second telephony devices are now available for new incoming telephony communications. In yet other embodiments, additional information about the telephony communication between the first and second telephony devices may be reported to the IP based PBX service provider. The method then ends.

In some embodiments, the profile database 412 of an IP based PBX service provider may include information about user preferences, and that information may be used to help control how calls are routed and connected. For example, a user could indicate that if he is busy on an existing call, any new incoming calls should be sent to voicemail. Alternatively, the user could indicate that if he is busy with an existing call, he should be notified of the new incoming call, so that the user can switch to the new incoming call, if desired. A variety of other preferences could likewise be stored in the profile database, and those preferences could be used by IP based PBX service provider to determine how to handle individual telephony communications.

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The above-described systems and methods make it possible for a first telephony device to conduct a telephony communication with a second telephony device without the involvement of assets of an IP based PBX system. Thus, the telephony devices can communicate even when an Internet connection is unavailable and/or when the IP based PBX system that normally facilitates such communications is unavailable or inoperative.

In the foregoing descriptions, it was assumed that in some instances, all IP telephony devices that are connected to the same local area network are associated with the same business or account. This may not always be the case. For example, two businesses may share the same local area network. In that instance, information provided by the individual IP telephony devices about which business or account they are associated with could be used to determine which IP telephony devices should receive local address information about other IP telephony devices, and vice versa.

Also, in some embodiments, a local area network could be located in a residence, as opposed to a business. In this instance, a typical IP telephony service provider would provide the IP telephony devices with telephony services. Under these circumstances, the IP telephony devices connected to the local area network could be used by members of the family that lives at the residence. All the same basic functions described above could still be provided by the IP telephony service provider. As a result, individual members of the family could contact one another over the local area network without establishing a telephony communication via the Internet and the IP telephone service provider.

Moreover, there may be instances where a multifamily dwelling, such as a condominium building or an apartment building, provides wireless access to all people in the multifamily dwelling over a single wireless local area network. However, each family could establish a separate account with an IP telephony service provider. Under these circumstances, when a first family member's IP telephony device registers with the IP telephony service provider, it would provide information about the account with which it is associated. The IP telephony service provider would then provide the first family member's IP telephony device with local address information for the IP telephony devices of other family members that are also registered under the same account. Further, certain IP telephony devices could be associated with the account, but not dedicated to an individual family member, such as an IP television, or central a residence telephony device. The local address information for those commonly used IP telephony devices also would be provided to the first family member's IP telephony device when it registers. This would allow each of the IP telephony devices associated with a single account to directly setup telephony communications with other IP telephony devices associated with the account, without the need for use of the IP telephony system assets. Also, although IP telephony devices that are associated with other accounts may utilize the same wireless local area network, each IP telephony device belonging to an account is only provided with local address information for the other IP telephony devices that are associated with the same account.

In many of the foregoing examples, IP telephony devices that utilize the services of an IP based PBX service provider obtain local address information from the IP based PBX service provider that enables the IP telephony devices to setup new telephony communications directly with other telephony devices, without the assistance of the IP based PBX service provider. However, the systems and methods described above are also applicable to IP telephony devices that utilize a regular IP telephony service provider. In other words, the IP tele-

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phony devices could receive the local address information from a regular IP telephony service provider, and the local address information would enable the IP telephony devices to setup new telephony communications with other telephony devices without the assistance of the IP telephony service provider.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A method, performed by a first Internet protocol (IP) telephony device that is directly coupled to a local area network and that is associated with a first business or account, for conducting an IP telephony communication with a second IP telephony device that is also connected to a local area network and that is associated with the first business or account, comprising:

receiving, from an IP telephony service provider, the local area network addresses of IP telephony devices that are also associated with the first business or account, wherein the received local area network addresses include at least a local area network address that is assigned to the second IP telephony device;
storing the received local area network addresses in a local memory of the first IP telephony device;
receiving, at the first IP telephony device, a request to setup a telephony communication with the second IP telephony device;
retrieving, from the local memory, the local area network address assigned to the second IP telephony device; and
establishing an IP telephony communication directly with the second IP telephony device using the local area network address assigned to the second IP telephony device that was retrieved from the local memory of the first IP telephony device.

2. The method of claim 1, wherein the local area network address information is received from an IP based private branch exchange service provider.

3. The method of claim 1, further comprising reporting information relating to the IP telephony communication to the IP telephony service provider.

4. The method of claim 3, wherein the reporting step comprises reporting to the IP telephony service provider that the first IP telephony device is engaged in a telephony communication.

5. The method of claim 4, wherein the reporting step further comprises reporting to the IP telephony service provider that the first IP telephony device is no longer engaged in a telephony communication.

6. The method of claim 3, wherein the reporting step comprises reporting to the IP telephony service provider that the

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first IP telephony device has commenced a telephony communication with the second IP telephony device.

7. The method of claim 1, wherein the local area network addresses are received from the IP telephony service provider via a public data network.

8. The method of claim 1, wherein the local area network addresses are received from the IP telephony service provider when the first IP telephony device conducts a registration process with the IP telephony service provider via a public data network.

9. The method of claim 8, wherein the local area network addresses are for other IP telephony devices that are currently registered with the IP telephony service provider.

10. The method of claim 1, wherein the first IP telephony device and the second IP telephony device are connected to the same local area network, and wherein the IP telephony communication established between the first and second IP telephony devices is conducted via data packets that only traverse the local area network.

11. The method of claim 1, wherein the first IP telephony device and the second IP telephony device are connected to first and second local area networks, respectively, that are controlled by the first business and that are connected via a virtual private network connection, and wherein the IP telephony communication established between the first and second IP telephony devices is conducted via data packets that only traverse the first and second local area networks and the virtual private network connection.

12. A first IP telephony device that is configured to conduct an IP telephony communication with a second IP telephony device, comprising:

a local memory for storing the local area network addresses of other IP telephony devices that are associated with the same business or account as the first IP telephony device;

means for receiving a request to setup a telephony communication with a second IP telephony device that is associated with the same business or account as the first IP telephony device; and

means for establishing an IP telephony communication directly with the second IP telephony device using local area network address information for the second IP telephony device that is retrieved from the local memory of the first IP telephony device.

13. A non-transitory computer readable medium storing thereon instructions which, when performed by one or more processors of a first Internet protocol (IP) telephony device that is directly coupled to a local area network and that is associated with a first business or account, cause the first IP telephony device to perform a method for conducting an IP telephony communication with a second IP telephony device that is also connected to a local area network and that is also associated with the first business or account, the method comprising:

receiving, from an IP telephony service provider, the local area network addresses of IP telephony devices that are also associated with the first business or account, wherein the received local area network addresses include at least a local area network address that is assigned to the second IP telephony device;

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storing the received local area network addresses in a local memory of the first IP telephony device;

receiving, at the first IP telephony device, a request to setup a telephony communication with the second IP telephony device; and

establishing an IP telephony communication directly with the second IP telephony device using the local area network address for the second IP telephony device that was retrieved from the local memory of the first IP telephony device.

14. The non-transitory computer readable medium of claim 13, wherein the local area network addresses are received from an IP based private branch exchange service provider.

15. The non-transitory computer readable medium of claim 13, wherein the method further comprises reporting information relating to the IP telephony communication to the IP telephony service provider.

16. The non-transitory computer readable medium of claim 15, wherein the reporting step comprises reporting to the IP telephony service provider that the first IP telephony device is engaged in a telephony communication.

17. The non-transitory computer readable medium of claim 16, wherein the reporting step further comprises reporting to the IP telephony service provider that the first IP telephony device is no longer engaged in a telephony communication.

18. The non-transitory computer readable medium of claim 15, wherein the reporting step comprises reporting to the IP telephony service provider that the first IP telephony device has commenced a telephony communication with the second IP telephony device.

19. The non-transitory computer readable medium of claim 13, wherein the local area network addresses are received from the IP telephony service provider via a public data network.

20. The non-transitory computer readable medium of claim 13, wherein the local area network addresses are received from the IP telephony service provider when the first IP telephony device conducts a registration process with the IP telephony service provider via a public data network.

21. The non-transitory computer readable medium of claim 20, wherein the local area network addresses are for other IP telephony devices that are currently registered with the IP telephony service provider.

22. The non-transitory computer readable medium of claim 13, wherein the first IP telephony device and the second IP telephony device are connected to the same local area network, and wherein the IP telephony communication established between the first and second IP telephony devices is conducted via data packets that only traverse the local area network.

23. The non-transitory computer readable medium of claim 13, wherein the first IP telephony device and the second IP telephony device are connected to first and second local area networks, respectively, that are controlled by the first business and that are connected via a virtual private network connection, and wherein the IP telephony communication established between the first and second IP telephony devices is conducted via data packets that only traverse the first and second local area networks and the virtual private network connection.

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